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## Review of the malacological list proposed by F. Sordelli in 1896 for the middle Pleistocene Piànico-Sèllere Basin (Bergamo, N Italy)

**Abstract** – The list of the fossil molluscs of the Piànico-Sèllere lacustrine Basin proposed by Sordelli (1896) has never been reviewed through the years. In the light of the palaeontological studies made on the basin and of the retrieval of the original material in the Sordelli Collection (Museo di Storia Naturale di Milano), it is now possible to review the malacological list and to suggest a stratigraphical collocation of his samples in the upper levels of the lacustrine phase of the Basin (MLP-Unit), on the basis of the palaeoenvironment reconstruction suggested by the malacofauna.

**Key-words:** continental molluscs, Sordelli, Piànico-Sèllere Basin, Pleistocene, Lombardy.

**Riassunto** – Revisione dell'elenco malacologico proposto da F. Sordelli nel 1896 per il bacino medio pleistocenico di Piànico-Sèllere (Bergamo, Nord Italia).

L'elenco dei molluschi fossili del bacino lacustre di Piànico-Sèllere proposto da Sordelli (1896) non è stato mai revisionato attraverso gli anni. Alla luce di alcuni studi paleontologici compiuti sul bacino e del ritrovamento del materiale originale nella Collezione Sordelli (Museo di Storia Naturale di Milano), è stato ora possibile revisionare l'elenco malacologico e suggerire una collocazione stratigrafica dei suoi campioni nei livelli superiori della fase lacustre del bacino (Unità MLP), sulla base della ricostruzione paleoambientale suggerita dalla malacofauna.

**Parole chiave:** molluschi continentali, Sordelli, Bacino di Piànico-Sèllere, Pleistocene, Lombardia.

### Introduction

The Piànico-Sèllere Basin is located in the Orobian Prealps (Bergamo, N Italy). It has recently been studied from many points of view (Moscariello *et al.*, 2000; Ravazzi, 2003; Ravazzi, 2006). In particular, new considerations have been made through the study of the malacological fossil record (Esu & Gianolla, in press): thanks to these multidisciplinary contributions the geological and palaeontological framework of the Basin is going to become increasingly clear.

A middle Pleistocene succession of lacustrine sediments can be recognized in the Basin (Moscariello *et al.*, 2000; Ravazzi, 2006). The main feature of the Basin is the long deposition of a sequence of varves (Ravazzi, 2003; Mangili *et al.*, 2005), constituting the unit called BVC – “Banco Varvato Carbonatico” (Varvate Carbonatic Bed). Uppermost of the BVC a mainly turbiditic unit, with some thin varved layers, is present: the MLP – “Membro di La Palazzina” (La Palazzina Member; for the stratigraphy of the Basin see Moscariello *et al.*, 2000 and Ravazzi, 2006). The most famous fossil retrieval in the Basin is the fossil deer (Confortini *et al.*, 2003), recognized as *Cervus elaphus acoronatus* Beninde, which allowed to date the Basin at middle Pleistocene (Govoni *et al.*, 2006). In the Basin two tephra layers are also present, and this evidence allows to place the Basin in the middle Pleistocene (Pinti *et al.*, 2001; Brauer *et al.*, 2007a), even if there are some problems of interpretation (Pinti *et al.*, 2007; Brauer *et al.*, 2007b).

The recent results update the knowledge developed through about 150 years of studies. The studies on the Piànico-Sèllere Basin, actually began during the second half of the XIX Century with many published papers (*e.g.* Stoppani, 1857, 1873, 1880; Bassani, 1886; Corti, 1892; Baltzer, 1893). In one of the most complete studies of this period about the palaeontology of the Basin Sordelli (1896) described in detail the palaeobotanical record of the Lombardy region (N Italy) and the associated fossil fauna. He was one of the first to list the fossils of the Piànico-Sèllere Basin: he carefully described the fossil leaves present in the sediments and reported some information about the other fossils. In the present work, we focus our attention on the malacological list of the Piànico-Sèllere Basin as presented by the author as follows (Sordelli, 1896: 205):

«*Sphaerium* sp.? Una valva assai guasta che per la forma generale riterrei appartenente a questo genere, mentre per la regolarità e rilievo delle linee di accrescimento potrebbe forse essere diversa dalle specie indigene.

*Unio longirostris* Ziegl. – Identica per la forma alla descrizione che ne dà Rossmassler. È una forma tutt'ora vivente della *U. pictorum* Linn.

*Bythinia tentaculata* (L.) ed opercoli della stessa specie.

*Planorbis carinatus* Müll.

*Limnaea* (sect. *Gulnaria*) cfr. *auricularia*.

*Zonites* sp. – Affine a *Z. verticillus* Fér. Non ho potuto stabilire la completa identità fra l'unico esemplare veduto e la specie vivente. Tuttavia rimane assodato come anche qui fosse rappresentato un genere di Gasteropodi terrestri ora affatto estraneo alla Lombardia, e proprio di paesi più orientali, avente la sua principale area di diffusione tra la Dalmazia e l'Asia minore.»

(«*Sphaerium* sp.? A very fail valve that, for the general shape, I would believe as belonging to this genus, while, for the regularity and the pronunciation of the growth lines, it could perhaps be different from the indigenous species.

*Unio longirostris* Ziegl. – Identical for shape to the description given by Rossmassler. It is a still living form of the *U. pictorum* Linn.

*Bythinia tentaculata* (L.) and opercula of the same species.

*Planorbis carinatus* Müll.

*Limnaea* (sect. *Gulnaria*) cfr. *auricularia*.

*Zonites* sp. – Similar to *Z. verticillus* Fér. I was not able to establish the complete identity between the unique observed specimen and the living species. However it

remains undisputed that also a terrestrial gastropod genus, now totally stranger from Lombardy and typical of more eastern countries, with its main distribution area between Dalmatia and Asia Minor, were here represented.»)

### Materials and methods

The material of the Sordelli Collection analyzed in the present work is kept in the Museo Civico di Storia Naturale di Milano. The Curator of the department of Invertebrate Palaeontology, G. Teruzzi, made the material available for study.

Not all the molluscs listed by Sordelli have been found in the Collection. The original description suggests that some whole shells were recovered and stored, whereas in the Sordelli's material only fragments of molluscs are visible in two little samples of sediment (Fig. 1). The catalogue numbers of the examined samples are MSNM B 3818 and MSNM B 3819. The stratigraphical context of the material is not reported by the author; just little information is reported in the original tag: «Farinose fossiliferous limestone. Interglacial. Piànico».

After the 1943 bombing, all the material stored in the Museo di Milano was sooted, therefore it became very difficult to study. An accurate cleaning with a dry paintbrush was necessary to analyse the material, but the procedure was not sufficient to remove the soot completely. For obvious reasons it was impossible to subject the material to a disaggregating treatment in  $H_2O_2$ .

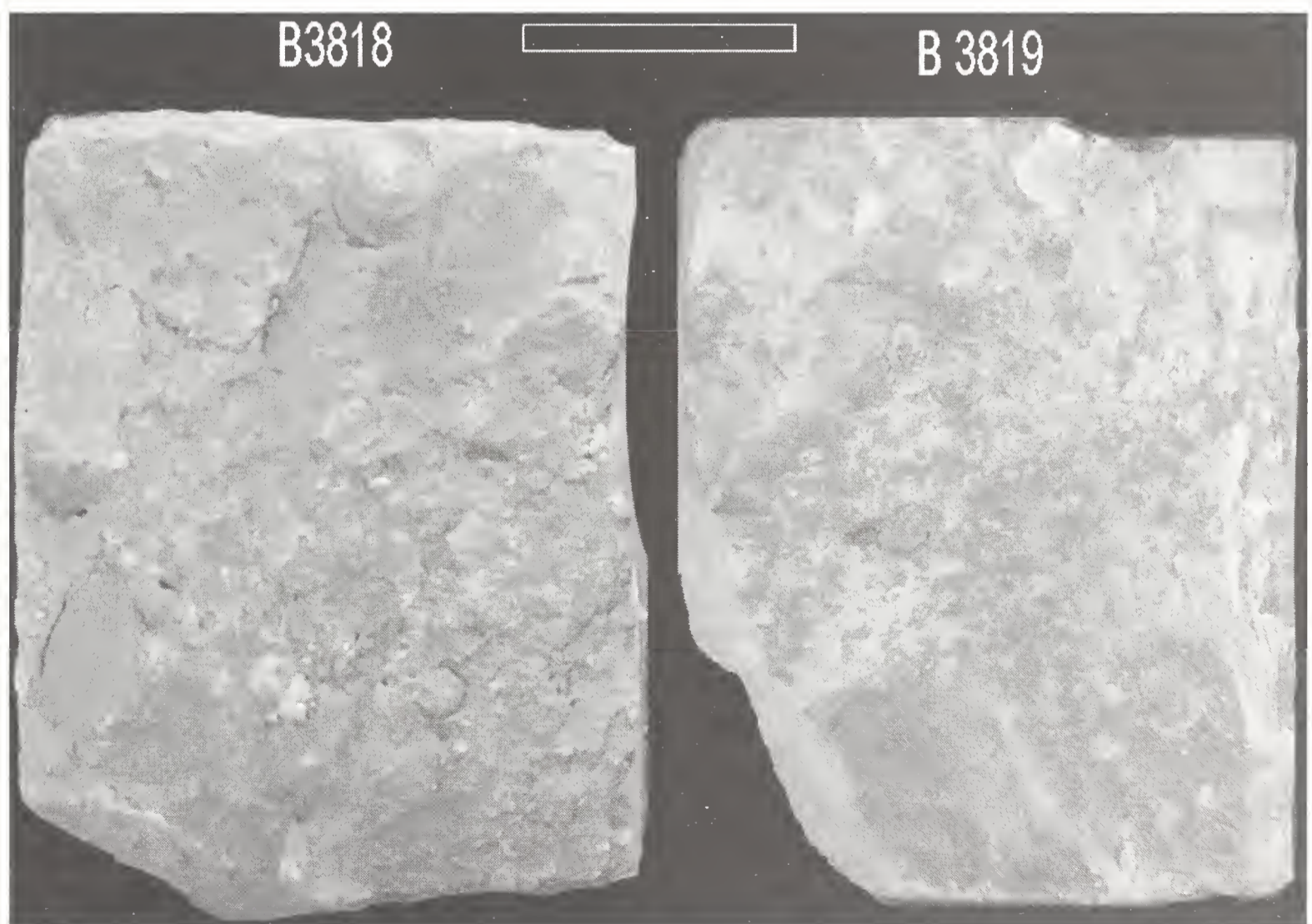


Fig. 1 – The two malacological samples kept in the Sordelli Collection in the care of the Museo di Storia Naturale di Milano. Scale bar: 5 cm.

Fig. 1 – I due campioni malacologici custoditi nella Collezione Sordelli presso il Museo di Storia Naturale di Milano. Barra dimensionale: 5 cm.

An observation by a stereo-microscope allowed to recognize the species and to give them an environmental significance, using the ecological marks proposed by Ložek (1964). The ecological marks utilized in the present work are: 10F for the species living in current waters, 10S for the species living in stagnant waters, 10SF for the species living in stagnant or current waters, 10F(S) for the species prevalently living in current but also in stagnant waters, 10S(F) for the species prevalently living in stagnant but also in current waters, 1W!! for the species living in woods that are also typical of temperate periods.

The material was compared with that coming from the Main Section (in which BVC and MLP crop out, Moscardiello *et al.*, 2000; Ravazzi, 2006), sampled by the writer, and from the Deer Section (the material is stored in the Museo Civico di Scienze Naturali “E. Caffi”, Bergamo, and is referred to the excavations S1660 and S1679 of the Museum).

## Results

Observing the samples of the Sordelli Collection, constituted by a whitish-yellowish, very farinose sediment, some laminated levels are visible on the side: they appear similar to varves but they are not so thin nor so clear like those present in the BVC unit (Fig. 2).

In the samples four taxa was recognized: the gastropods *Bithynia* cf. *B. tentaculata* (Linnaeus) and *Planorbis* cf. *P. carinatus* (Müller), the bivalves *Pisidium* sp. and *Unio* sp.

In the light of this recognized molluscs and of the molluscs recovered in four stratigraphical sections and a deep core of the Basin (Esu & Gianolla, in press), it is possible to review the malacological list proposed by Sordelli:

- «*Sphaerium* sp.?» In the samples of the Sordelli Collection no traces of the genus *Sphaerium* Scopoli were found: the unique small bivalve recovered in the samples was attributed to the genus *Pisidium* Pfeiffer for its shape and its dimensions (Fig. 3A). Up to now no remains attributable to *Sphaerium* were found in the Basin (in the samples from the sections or from the core), thus it is not yet possible to confirm its presence. However D. Esu (pers. comm.) signalled some bivalves

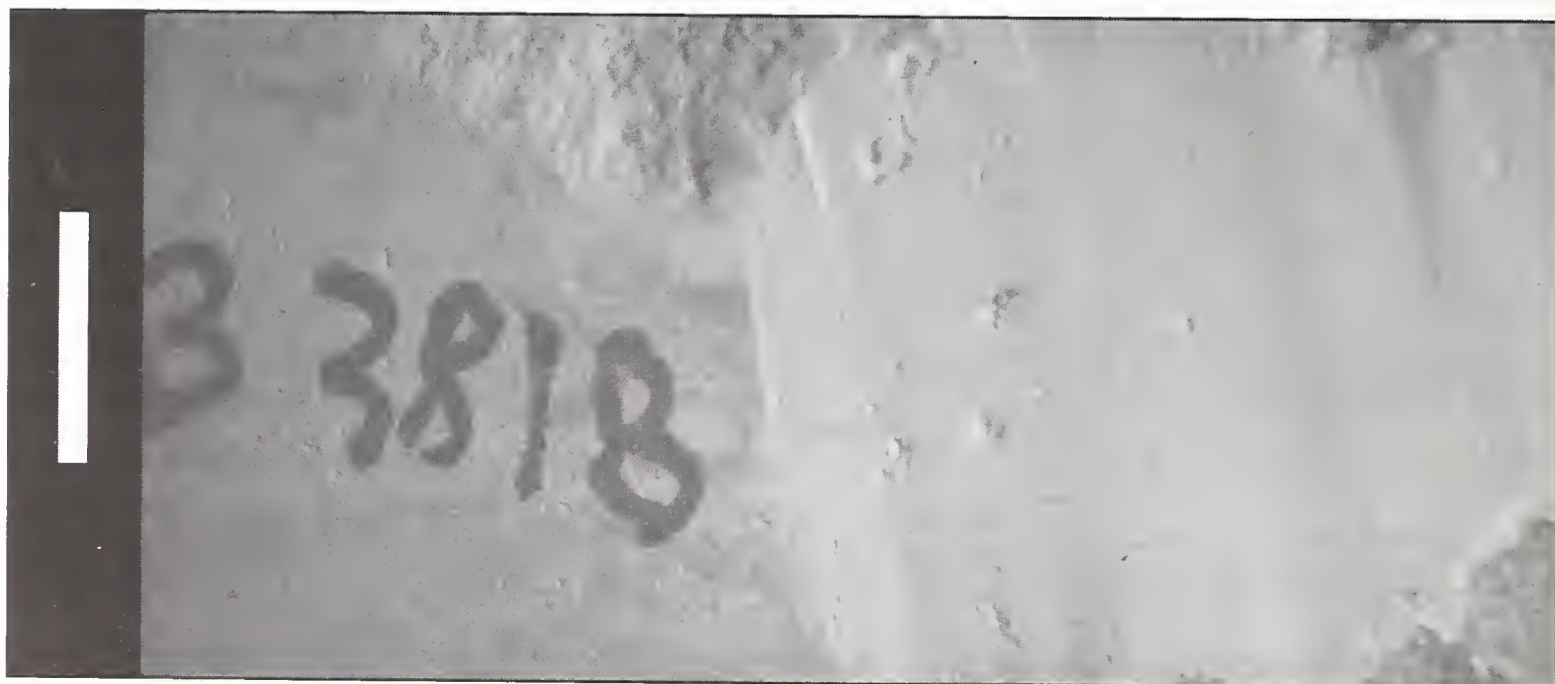


Fig. 2 – The board of the sample MSNM B 3818. Scale bar 1 cm.

Fig. 2 – Bordo del campione MSNM B 3818. Barra dimensionale 1 cm.

found out of a stratigraphical context which, for shape and dimensions (about 1 cm in length), can dubitatively be attributed to this genus (the material is not available). All the small bivalves recorded in the stratigraphical sections and in the core were attributed to the genus *Pisidium*: it is present in almost all the analyzed samples of the Basin (Esu & Gianolla, in press). The genus includes many species, representative of different environments, therefore it is not possible to assign an ecological mark to the whole genus. In the material sampled from the sections the following species were identified: *P. henslowanum* (Sheppard) (largely diffused in rivers, channels, streams and low altitude lakes (Castagnolo *et al.*, 1980); ecological mark: 10F(S)), *P. cf. milium* Held (in rivers, lakes, streams and channel, rarely in still waters (Castagnolo *et al.*, 1980); ecological mark: 10SF), *P. cf. nitidum* Jenyns (in rivers, streams, lakes and ponds (Castagnolo *et al.*, 1980); ecological mark: 10F(S)), *P. cf. subtruncatum* Malm (it prefers stream waters but it occurs also in still waters (Castagnolo *et al.*, 1980); ecological mark: 10SF), *P. cf. personatum* Malm (largely diffused in every freshwater environment (Castagnolo *et al.*, 1980); the species is not mentioned by Ložek (1964)).

- «*Unio longirostris* Ziegl.» The systematic of the genus *Unio* Retzius is complex and it underwent many revisions through the years (Zilch, 1967; Graf, 2007). *U. longirostris* Ziegler is a synonym of *U. rostratus* Lamarck (Graf & Cumings, 2007a), which can be included in the species *U. pictorum* (Linnaeus) (Graf, 2007). At present, just the species *U. elongatulus* Pfeiffer is signalled in Italy (Castagnolo *et al.*, 1980). The relationship between *U. pictorum* and *U. elongatulus* is not very clear (Araujo *et al.*, 2005) but following Modell (1964) both species belong to the same “*U. pictorum* group” and might represent a case of speciation in action (Badino *et al.*, 1991). Graf & Cumings (2007b) do not consider *U. elongatulus* in their checklist of the family Unionidae: more comparisons are now necessary to correctly locate the specimens found in the Piànico-Sèllere Basin. Just a little fragment attributable to *Unio* sp. was found in the samples of the Sordelli Collection (Fig. 3B), but the genus was found in many levels sampled in the other part of the Basin (Esu & Gianolla, in press): a whole valve (dubitatively attributable to *U. cf. elongatulus*) was found in the excavation S1679 by the staff of the Museum “E. Caffi” (Fig. 3G, the stratigraphy of the sample is not available). The species *U. elongatulus* is signalled in the freshwaters of the whole Mediterranean Basin (Castagnolo *et al.*, 1980); following Ložek (1964, in which the species *U. elongatulus* is not described) the genus *Unio* usually indicates current waters (e.g. *U. pictorum*: mark 10F).

- «*Bythinia tentaculata* (L.)» is a synonym of *Bithynia tentaculata* (Linnaeus). The presence is confirmed but a more prudent *B. cf. tentaculata* should be used because of the bad preservation of the material (Fig. 3C). The species (mark 10SF) characterizes environments of slow current or stagnant waters (Girod *et al.*, 1980). In the Basin, almost all remains of *Bithynia* are represented by opercula and this was interpreted as the clear evidence of a transport (Esu & Gianolla, in press).

- «*Planorbis carinatus* Müll.» The presence of the species *P. carinatus* (Müller) is confirmed. In the samples of the Sordelli Collection some badly preserved shells are present: the taxon *P. cf. carinatus* (Müller) is preferred for identification, because it is more appropriate (Fig. 3E, F). The species (mark 10S) lives in stagnant waters (Girod *et al.*, 1980). In the cropping out sections of the Basin some fragments or some whole shells included in the sediment were found (Gianolla, 2006; Esu & Gianolla, in press).

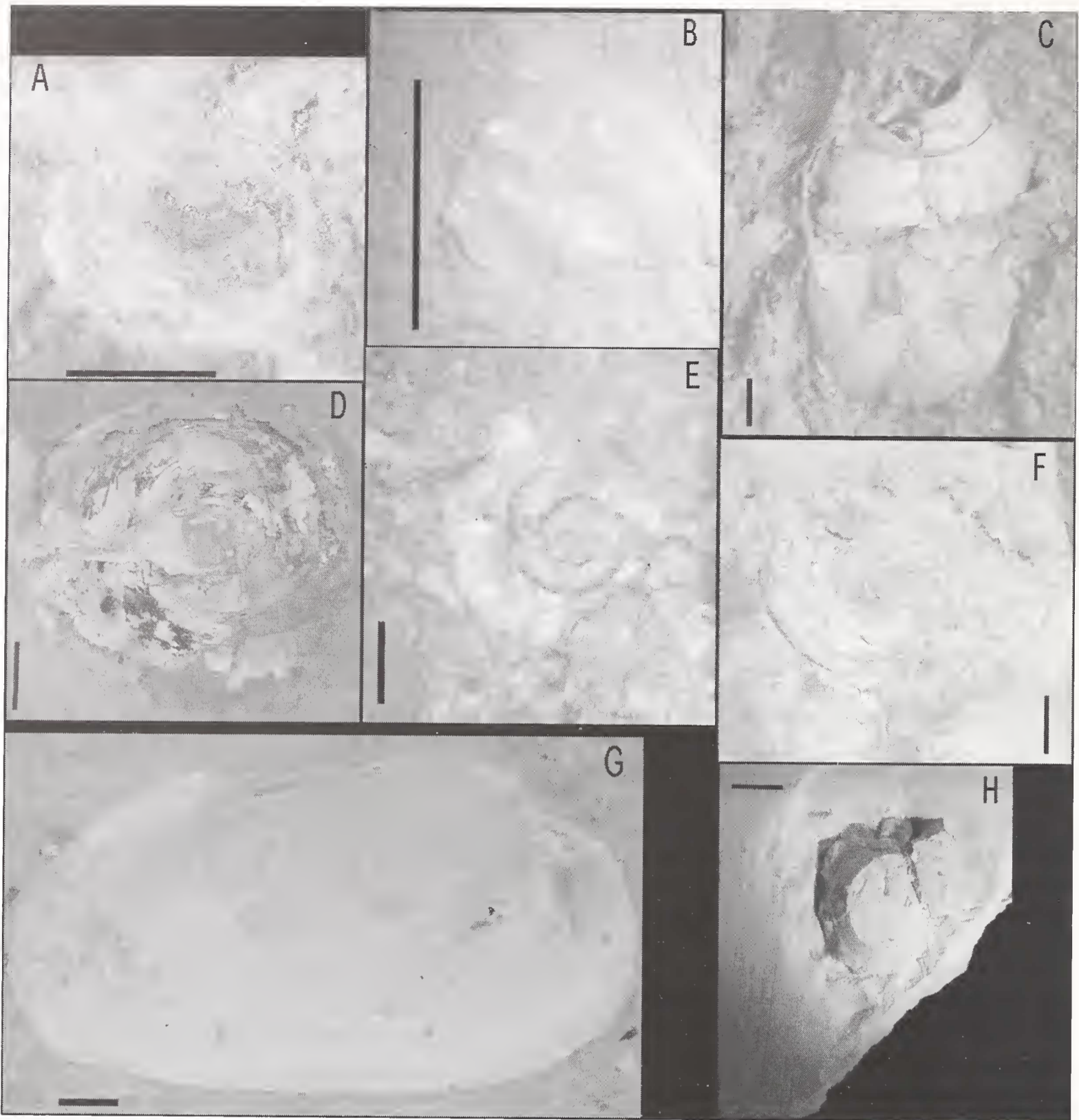


Fig. 3 – A) *Pisidim* sp. from sample MSNM B 3819 of the Sordelli Collection. Scale bar: 1 mm. B) Fragment of *Unio* sp. from sample MSNM B 3819 of the Sordelli Collection. Scale bar: 5 mm. C) *Bithynia* cf. *B. tentaculata* (Linnaeus) from sample MSNMB 3818 of the Sordelli Collection. Scale bar: 1 mm. D) Gastropoda indet. (terrestrial?) from excavation S1679 of the Museo Civico di Scienze Naturali “E. Caffi”, Bergamo. Scale bar: 5 mm. E) *Planorbis* cf. *P. carinatus* Müller from sample MSNM B 3818 of the Sordelli Collection. Scale bar: 1 mm. F) *Planorbis* cf. *P. carinatus* Müller from sample MSNM B 3819 of the Sordelli Collection. Scale bar: 1 mm. G) *Unio* cf. *U. elongatulus* Pfeiffer from excavation S1679 of the Museo Civico di Scienze Naturali “E. Caffi”, Bergamo. Scale bar: 5 mm. H) *Radix* cf. *R. auricularia* (Linnaeus) from excavation S1660 of the Museo Civico di Scienze Naturali “E. Caffi”, Bergamo. Scale bar: 5 mm.

Fig. 3 – A) *Pisidim* sp. dal campione MSNM B 3819 della Collezione Sordelli. Barra dimensionale: 1 mm. B) Frammento di *Unio* sp. dal campione MSNM B 3819 della Collezione Sordelli. Barra dimensionale: 5 mm. C) *Bithynia* cf. *B. tentaculata* (Linnaeus) dal campione MSNM B 3818 della Collezione Sordelli. Barra dimensionale: 1 mm. D) Gastropoda indet. (terrestre?) dallo scavo S1679 del Museo Civico di Scienze Naturali “E. Caffi” di Bergamo. Barra dimensionale: 5 mm. E) *Planorbis* cf. *P. carinatus* Müller dal campione MSNM B 3818 della Collezione Sordelli. Barra dimensionale: 1 mm. F) *Planorbis* cf. *P. carinatus* Müller dal campione MSNM B 3819 della Collezione Sordelli. Barra dimensionale: 1 mm. G) *Unio* cf. *U. elongatulus* Pfeiffer dallo scavo S1679 del Museo Civico di Scienze Naturali “E. Caffi”, Bergamo. Barra dimensionale: 5 mm. H) *Radix* cf. *R. auricularia* (Linnaeus) dallo scavo S1660 del Museo Civico di Scienze Naturali “E. Caffi”, Bergamo. Barra dimensionale: 5 mm.

- «*Limnaea* (sect. *Gulnaria*) cfr. *auricularia*» is a synonym of *Radix auricularia* (Linnaeus). It is not present in the samples of the Sordelli Collection. A specimen attributable to *R. cf. auricularia* was found in the upper part of MLP, in the levels containing the fossil deer (Fig. 3H). Moreover in the Piànico Basin the genus *Radix* Montfort is represented by some small apexes assigned to the taxon *R. cf. peregra* (Müller): however the morphology of the two species is not easily recognizable (Girod *et al.*, 1980), thus it is not possible to definitively distinguish the two species without the entire shell. The species *R. auricularia* (mark 10S) lives in the stagnant waters (Girod *et al.*, 1980), while *R. peregra* (mark 10S(F)) can also live in waters with a slow current (Girod *et al.*, 1980).

- «*Zonites* sp. – Similar to *Z. verticillus* Fér.». *Zonites verticillus* Ferrussac is a synonym of *Aegopis verticillus* (Férussac). It seems to be the only terrestrial record found in the whole Basin. It is not present in the samples of the Sordelli Collection nor in the material sampled in the cropping out sections of the Basin, so its presence cannot be confirmed. A possible terrestrial mollusc was recovered in the damming S1679 of the Museum “E. Caffi”: it is not recognizable but its dimensions are compatible with those of *A. verticillus* (Fig. 3D, the stratigraphical context of the sample is not available). The ecological mark of the species is 1W!/: it indicates a wood environment in a temperate period. Following Girod (1973), the species is known in Lombardy for the Riss-Würm interval in the Zandobbio’s breccia (Bergamo). Since the retrieval was not confirmed for the Piànico-Sèllere Basin, it is not possible to consider its ecological mark for the environmental reconstruction, however the presence of a whole shell of a terrestrial mollusc could indicate an environment of shallow, undisturbed waters.

## Discussion

The malacofauna recovered in the samples of the Sordelli Collection (in particular the presence of shells attributable to the genus *Planorbis*), also considering the kind of the sediment, suggests a stagnant, shallow waters environment. Some clearly transported elements (*e.g.* the fragments of *Unio* sp.) suggest the presence of a contribution of a small water course. The deposit with the described malacofauna could have been accumulated in a margin context, particularly if the presence of terrestrial molluscs will be confirmed.

The temperate genus *Tanousia* Servain (extinct in Italy), characterizing the all BVC and the lower part of MLP (Esu & Gianolla, 2008), is completely absent both in the list proposed by Sordelli and in his samples: it appears unlikely that the material was sampled in the BVC unit or in the lower part of MLP, it appears more probable that it was sampled from the upper part of MLP, in correspondence of a climatic worsening (Esu & Gianolla, in press).

The Molluscan fauna of the samples of the Sordelli Collection appears comparable to the assemblages present in the levels of the upper part of MLP (see Gianolla, 2006 and Esu & Gianolla, in press) containing the fossil deer (Confortini *et al.*, 2003; Govoni *et al.*, 2006). Here a shallow water context is represented, with evidence of a slow transport and a build-up of molluscs: this was interpreted as a margin context. The genera *Planorbis*, *Bithynia*, *Unio* and *Pisidium* were recognized also in the deer levels (while *Tanousia* is absent) and their preservation state

is similar to the preservation state of the material recorded in the samples of the Sordelli Collection.

In conclusion, it is possible to suggest a correspondence between the two environmental contexts on the basis of the described similarities.

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